

CLAIMS

1. A separating device for removing objects from an object stream, the device comprising a two dimensional array of individually actuatable air jet nozzles, a
5 group of said nozzles being selectably actuated to remove a said object from the object stream.
2. A device as claimed in Claim 1, wherein the separating device includes a controller responsive to object data identifying objects in said object stream
10 to selectably actuate said group of nozzles corresponding to an object outline contained in said object data.
3. A device as claimed in Claim 1 or Claim 2, further comprising a conveyor arranged to receive said object stream, the conveyor being permeable to a
15 gas jet emitted by said array, the array being positioned such that said conveyor is interposed between said array and said object stream.
4. A device as claimed in Claim 3, wherein said conveyor comprises a meshed belt.
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5. A device as claimed in Claim 3, wherein said conveyor comprises a set of rollers.
6. A device as claimed in Claim 5, wherein at least one roller in said set is
25 driven.

7. A device as claimed in any one of Claims 1 to 6, wherein the nozzles are arranged in a substantially rectangular array of n rows by m columns.
8. A device as claimed in any one of Claims 1 to 7, wherein a plurality of
5 nozzles are connected to a manifold.
9. A device as claimed in any one of Claims 1 to 8, wherein the nozzles are connected to a compressed air supply.
- 10 10. A device as claimed in Claim 2, wherein the controller is operable in response to data identifying an object in said stream to actuate nozzles in at least two columns.
11. Sorting apparatus (10; 50) comprising
- 15 (a) conveying means for conveying input objects (13; 53) input to the apparatus;
- (b) extraction means (17, 18, 20, 21; 58, 60) for extracting from the conveying means input objects identified as belonging to a particular object-class and removing said identified input objects to a remote location; and
- 20 (c) processing means (16; 56) arranged to
- (i) receive input data corresponding at least to the positions across the conveying means of said identified input objects; and
- (ii) output control signals corresponding to the input data to the
25 extraction means at an appropriate time to effect extraction of said identified input objects;

wherein the extraction means comprises an array of nozzles (32), extending in a direction (z) across the conveying means, each of which is independently operable under control of the processing means to produce an air jet in a generally upward direction (y), and is arranged to activate sub-
5 groups of nozzles corresponding to, and in response to, said control signals; characterised in that

- (d) the conveying means has a partially-open surface (12; 62, 64) arranged to convey input objects over the array of nozzles;
- (e) the array of nozzles is two-dimensional and also extends in a direction
10 (x) substantially parallel to the direction of motion of the conveying means when the apparatus is in use; and
- (f) the input data further corresponds to the outline shapes of said identified input objects.

15 12. Apparatus (10) according to claim 11 wherein the extraction means (17, 18, 20 and 21) comprises two or more two-dimensional arrays of nozzles, the conveying means being arranged to convey input objects over the two or more arrays and each array being arranged to extract from the conveying means input objects belonging to at least one of a plurality of object-classes
20 in response to control signals from the processing means (16).

13. Apparatus (50) according to claim 11 wherein the extraction means comprises first and second two-dimensional arrays of nozzles and the apparatus comprises first and second conveying means having partially
25 open surfaces (62, 64) arranged to convey input objects over the first and second arrays respectively, each array being arranged to extract from

corresponding conveying means input objects belonging to at least one of a plurality of object-classes in response to control signals from the processing means (56).

- 5 14. Apparatus according to claim 11 further comprising means (14; 54) arranged to identify input objects composed of a particular material and to pass corresponding data to the processing means (16; 56).
- 10 15. Apparatus according to claim 14 wherein said means is also arranged to establish the positions of identified input objects across the conveying means and to pass corresponding data to the processing means (16; 56).
16. Apparatus according to Claim 15, wherein said corresponding data comprises a timestamp .
- 15 17. Apparatus according to claim 15 or Claim 16 wherein said means is also arranged to establish the outline shapes of identified input objects and to pass corresponding data to the processing means (16; 56).
- 20 18. Apparatus according to claim 17 wherein said means comprises an imaging sensor.
- 25 19. Apparatus according to claim 11 and further comprising one or more tracking cameras arranged to track the positions of input objects on the conveying means between the position at which the input objects are input to the apparatus and the position of the array of nozzles, and to provide corresponding data to the processing means.

20. Apparatus according to claim 11 wherein the conveying means is a meshed conveyor belt.
- 5 21. Apparatus according to claim 20 wherein the meshed conveyor belt has a meshed conveying surface with an open area fraction of at least 60%.
22. Apparatus according to claim 21 wherein the meshed conveying surface is made from one of plastic, metal and PTFE-coated fibre-glass.
- 10 23. Apparatus according to claim 11 wherein nozzles (32) in the array are arranged in rows having a nozzle pitch A , the pitch of the rows in a direction substantially perpendicular to the rows is A , and adjacent rows are offset in said direction by a distance $A/2$.
- 15 24. Apparatus according to claim 23 wherein $1\text{cm} \leq A \leq 2\text{cm}$.
25. Apparatus according to claim 11 wherein each nozzle has an independent supply (39) of pressurised air.
- 20 26. Apparatus according to claim 11 wherein subgroups of nozzles are connected to respective manifolds (40) each of which has an independent supply (41) of pressurised air.

27. Apparatus according to claim 11 wherein each nozzle incorporates a valve and a solenoid arranged to open and close the valve in response to control signals.
- 5 28. Apparatus according to claim 11 wherein the extracting means may be adjusted to vary one or more of the speed, direction and duration of the air jets produced by the array of nozzles in response to control signals from the processing means.
- 10 29. A method of sorting objects, the method comprising the steps of
- (a) conveying an stream of input objects on conveying means;
 - (b) identifying objects in the input stream which belong to a particular object-class;
 - (c) determining the positions across the conveying means of objects
 - 15 identified in step (b); and
 - (d) applying upwardly-directed air-jets to an identified object at an appropriate time, and at an appropriate position in a direction across the conveying means, to remove the identified object to a location corresponding to the object-class;
 - 20 characterised in that the method further comprises the steps of
 - (d) determining the outline shapes of said identified objects;
 - (e) applying upwardly-directed air jets to the identified object, at the time and position specified in step (d), over an area of the object corresponding to its outline shape.